

## X. A NEW ANOSTEIRID FROM THE UINTA EOCENE.

BY JOHN CLARK.

The specimen here described was collected by Mr. J. LeRoy Kay, in charge of field-work for the Section of Vertebrate Paleontology, Carnegie Museum, in 1930. It was found in the Leota Quarry,<sup>1</sup> Uinta County, Utah. The study of the specimen was pursued under the general direction of Mr. O. A. Peterson, Curator of Fossil Mammals, Carnegie Museum. The illustrations are from drawings by Mr. Sydney Prentice. Mr. Barnum Brown, Curator of Fossil Reptiles in the American Museum of Natural History, very kindly lent for comparison the shell of *Anosteira ornata* (A. M. N. H., No. 6132) described by Hay.<sup>2</sup>

Family DERMATEMYDIDÆ Gray.

SUBFAMILY ANOSTEIRINÆ Lydekker.

***Pseudanosteira*\* *pulchra*, gen. et sp. nov.**

*Type*: Complete carapace, almost complete hyoplastra, hypoplastra, and anterior extremities of xiphyplastra (C. M., No. 11808).

*Horizon*: Upper part of Horizon C, Uinta Eocene.

*Locality*: Quarry L. Leota Ranch, near Green River, six miles above Ouray, Uinta County, Utah.

*Generic characters*: Carapace ovate in outline, emarginate anteriorly; posteriorly there is a median dorsal carina. Ten pairs of peripherals, eight pairs of costals, seven neurals. First costal in contact with first neural only. Fourth costal in contact with fourth neural only. Neurals highly differentiated: first and fourth octagonal; second, third, and fifth tetragonal; sixth and seventh hexagonal. Costals ornamented with obsolete transverse ridges; peripherals with pustules and acute vermicular ridges. First vertebral scute bisected

<sup>1</sup>See *Ann. Carn. Mus.*, Vol. XX, Plates IV, X.

<sup>2</sup>Hay, O. P. *Fossil Turtles of North America*. Carnegie Institution of Washington, 1908. pp. 279-281.

\**Ψευδος* = false; *ἀνοστειρα* = Name of a genus of fossil turtles set up by Prof. Leidy.

anteriorly by a median sulcus, posteriorly by the anterior end of the second vertebral scute. Second vertebral scute embraced posteriorly by the antero-lateral tips of the third vertebral scute. Fourth vertebral scute very much reduced. Fourth costal scute bordered by third, fourth, and fifth vertebral scutes. Plastron, so far as known, as in *Anosteira ornata*.

In its general features, the carapace resembles that of *Anosteira ornata* (A. M. N. H. No. 6132). Its outline is broadly oval, with a shallow anterior emargination; a strong median carina rises as a blunt, posteriorly directed spine on the third and fourth neurals, and continues almost to the free border of the pygal. The shell is almost twice as large as that of *A. ornata*, and seems to be less highly arched, but crushing in all the specimens makes the latter character difficult to determine. The sculpture is like that of *A. ornata*, but is much less clearly expressed, especially upon the costals and the plastron, which are almost smooth.

Examination of the bony structure of the carapace reveals a degree of specialization much greater than in the case of *Anosteira*. The sutures between the first and second costals meet the first neural about one-third of its length from its posterior end, rather than meeting the anterior part of the second neural. The suture between the second and third costals is continuous on the left side with the suture between the second and third neurals, and on the right side meets the second neural immediately anterior to its posterior suture. The fourth neural receives, near its anterior end, the sutures between the third and fourth costals, and near its posterior end the sutures between the fourth and fifth costals. The sixth neural receives the sutures between the fifth and sixth costals and the seventh neural receives the sutures between the sixth and seventh costals, as in *Anosteira*. The first and fourth neurals are octagonal; the second, third, and fifth are tetragonal; and the sixth and seventh are hexagonal. The nuchal, supra-pygal, and peripherals are similar to the corresponding bones in *Anosteira*. As in *Anosteira*, the free borders of the anterior peripherals are rounded and sub-acute, while the borders of the posterior peripherals are acute.

In marked contrast to the condition of the bony plates, the scutes are much more primitive than those of *Anosteira*, and present the key to certain formerly little understood trends of specialization of the Anosteirid epidermal armor.

The first vertebral scute resembles that of *Anosteira* in all important respects. The second vertebral scute, which has lost its identity in *Anosteira*, thrusts the median spike of its helmet-shaped anterior end between the lateral wings of the divided first vertebral scute as far as the posterior part of the first neural. The wings of the first vertebral extend back to a point two-thirds of the length of the second vertebral toward its posterior end. The posterior termination

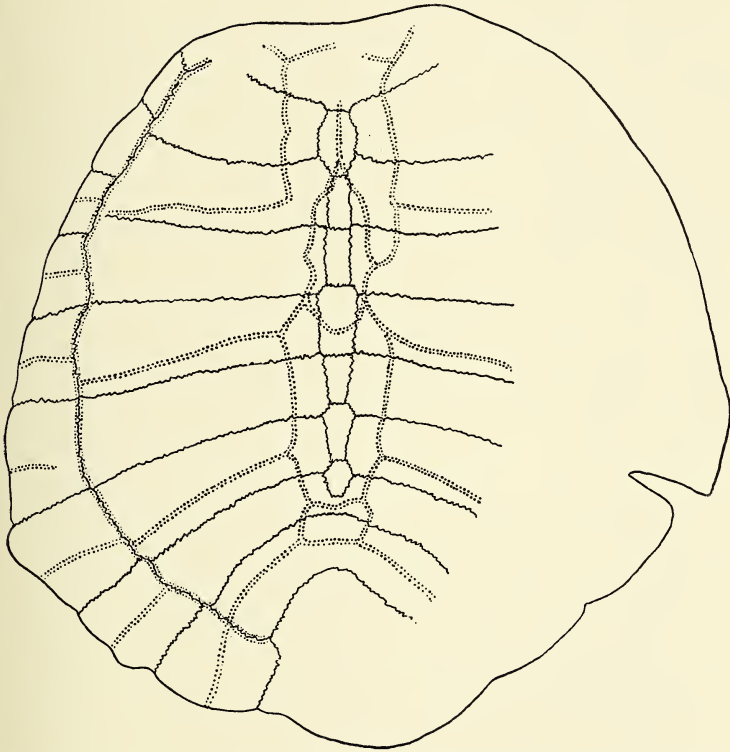


FIG. 1. Dorsal View of Shell of *Pseudanosteira pulchra*, *sp. nov.* (C. M. Cat. Vert. Foss., No. 11, 808)  $\frac{1}{2}$  nat. size.

of the second vertebral scute is convex, set firmly in the median anterior socket of the third vertebral. The third vertebral scute is very long, extending from the fourth neural back almost to the anterior suture of the eighth costal bones; it is met at its widest point by the sulcus between the second and third costal scutes and more posteriorly by the sulcus between the third and fourth costal scutes.

The fourth vertebral is reduced, almost extinct. It is a small, rectangular scute, with its anterior third resting upon the seventh costal plates and its posterior two-thirds upon the eighth costal plates. The fifth vertebral scute is triangular with curved borders, and is wider than is the corresponding scute in *A. ornata*.

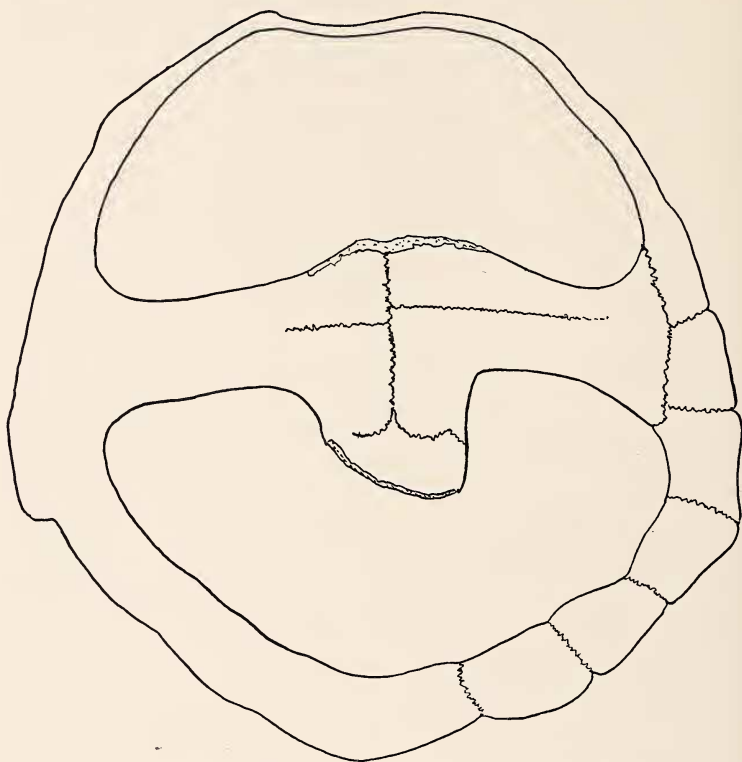


FIG. 2. Ventral View of Shell of *Pseudanosteira pulchra*, *sp. nov.* (C. M. Cat. Vert. Foss., No. 11,808)  $\frac{1}{2}$  nat. size.

The costal scutes are simple; the changes in their relationships to the various vertebral scutes has been caused entirely by modification of the vertebral series.

Hay, referring to *Anosteira ornata* (A. M. N. H. No. 6132) says<sup>3</sup> "From this and other specimens it becomes quite certain that (the costo-marginal sulci) ran along the upper borders of the peripherals, just below the costo-peripheral sutures." I have not found satis-

<sup>3</sup>Hay, O. P., *op. cit.*, p. 280.

factory evidence in Hay's specimen, and certainly there is none in *Pseudanosteira*, for supposing that the costo-marginal sulci ran otherwise than coincident with the costo-peripheral sutures. Therefore, the costo-marginal sulci of *Pseudanosteira* may be supposed, until evidence is found to the contrary, to be coincident with the costo-peripheral sutures. The "other specimens" which Hay mentions may have furnished him with good evidence for *Anosteira*, but this does not have bearing upon the condition in *Pseudanosteira*.

The marginal scutes possess no distinctive characteristics.

The nuchal scute is narrower antero-posteriorly than the nuchal of *Anosteira* and is contained within the borders of the nuchal plate rather than reaching them laterally, as does the nuchal scute of *Anosteira*.

The portion of the plastron which has been preserved resembles the corresponding plastral region of *Anosteira ornata* in all its significant characters.

Through the anatomical characteristics which have constituted the subject of the foregoing description, *Pseudanosteira* illuminates several points formerly not understood in the phylogeny of the *Anosteirids*.

That the neural series is more highly developed than the neural series of *Anosteira* and *Pseudotrionyx* is obvious. Dr. Leidy's first description of the type material of *Anosteira ornata*<sup>4</sup> is brief, is not accompanied by illustrations, and is necessarily limited by the fragmentary nature of his specimens. In 1873 he published<sup>5</sup> a more complete description, in which he says the "vertebral plates of the carapace are narrow coffin-shaped," which may mean anything from tetragonal to octagonal. However, his illustration shows neurals numbers three, four, five, and six as hexagonal, while number seven is pentagonal, exactly as those bones are shaped in *Å. M. N. H. No. 6132*<sup>6</sup>. Moreover, in both Dr. Leidy's specimens and Dr. Hay's, each neural is met at its lateral angles by the sutures demarcating the anterior borders of its accompanying costals. In his description of the type of *Pseudotrionyx* (which Hay considers closely related to *Anosteira*), Dollo says,<sup>7</sup> "quatre plaques vertebrales hexagonales, dont

<sup>4</sup>Leidy, Joseph. Proc. Acad. Nat. Sci. Phila., 1871, p. 102.

<sup>5</sup>Leidy, Joseph. Contrib. Ext. Fauna West. Terrs. 1873., p. 175, Plate XVI.

<sup>6</sup>See Hay, O. P., *op. cit.*, p. 280 and Plate 43.

<sup>7</sup>Dollo, M. L. Bull. Musée Roy. D'Hist. Naturelle de Belgique. Vol. IV, 1884. "Première Note sur les Cheloniens du Bruxillien (Eocene Moyen) de La Belgique," p. 92, and Plates I and II.

chacune est comprise entre quatre plaques costales, la plus postérieure étant saisie entre les plaques C<sub>6</sub> et C<sub>7</sub> droites et gauches"—a charming description of exactly the condition which exists in *Anosteira*. To recapitulate briefly the specializations in *Pseudanosteira*, the sutures between costals one and two, between costals two and three, and between costals four and five, have migrated anteriorly so that they meet in each case the posterior part of the neural preceding their own; while neurals one and four have become octagonal, neurals two, three, and five have become tetragonal, and neural seven has become hexagonal.

As both *Pseudotrionyx* and the specimens of *Anosteira* in which the median portion of the carapace is known occurred in beds no higher than the middle Eocene, were it not for the epidermal peculiarities of the present specimen, one might suppose that the differentiation of the neural and costal bones was merely the development to be expected within a phylum<sup>8</sup> in a considerable period of time, and that the specimen represents an advanced species of *Anosteira*.

The fact that the vertebral scutes of *Pseudanosteira* are much less highly specialized than those of *Anosteira* indicates definitely that the two are members of different phyla, which separated long before Bridger times; the one developing a highly specialized epidermal armor and retaining a primitive arrangement of bones (*Anosteira*), while the other retained the more primitive epidermal structure and modified the bones of the carapace (*Pseudanosteira*).

Hay's discussion of the process of development of the vertebral scutes in *Anosteira*<sup>9</sup> gives the most logical order of events in the light of the evidence available to him. The present specimen, however, makes necessary important modifications of his ideas.

Hay believed that "the first and second normal vertebrals have coalesced." The anteriormost vertebral of *Pseudanosteira* is developed almost exactly as is the corresponding vertebral of *Anosteira*, and it embraces with its posterior wings the second vertebral, which lies in a position homologous to that of what Hay considered the anterior extension of vertebral three. Apparently, then, the normal second and third vertebrals of *Anosteira* have coalesced, while the wings of the first have extended posteriorly around the second, cutting

<sup>8</sup>Using the word "phylum" in the sense in which it is employed by Prof. H. F. Osborn in his monograph on the Titanotheres, U. S. G. S., Monograph 55.

<sup>9</sup>Hay, O. P., *op. cit.*, p. 281.

it off from its normal junction with the sulcus between the first and second costal scutes. This is borne out by the fact that the anterior part of the sulcus between the first and second vertebrae of *Pseudanosteira*, and that between the first and coalesced second and third of *Anosteira*, still rests on the first neural as in other turtles.

The posterior part of the second vertebral of *Pseudanosteira* has extended backward as a median wedge, flanked by the lateral tips of the third vertebral, which reaches toward the old position of the intervertebral sulcus on the third neural and costal bones.

The fourth vertebral has been driven from its junction with the sulci between the third and fourth costal scutes by the backward extension of the third vertebral, and has been crowded almost to non-existence against the anterior border of the fifth vertebral. In *Anosteira*, the third vertebral has reached the suture between the seventh and eighth costal bones, and the fourth vertebral has coalesced with the fifth, while in *Pseudanosteira* the third vertebral has not reached the suture and the fourth vertebral retains its identity.

In brief, modification of vertebral scutes in the *Anosteirinae* has taken place by the median bifurcation of the first vertebral, the posterior extension of the first, second, and third, and the partial suppression of the fourth. In the *Anosteira* phylum, the second and third have coalesced and also the fourth and fifth.

Ever since Dr. Leidy's original description there has been much debate, occasionally acrimonious, as to the taxonomic position of the genus *Anosteira*. (See papers by Leidy, Cope, Lydekker, Baur, Boulenger, Hay, and others, referred to in Hay's *Bibliography and Catalogue of the Fossil Vertebrates of North America*, 1930, under the heading "*Anosteiridae*" pp. 91, 92.). In his monograph on the Turtles, Hay gave a definition of the family *Dermatemydidae*<sup>10</sup> and included under it the genus *Anosteira*. Following Baur, Hay in 1902 and again in 1930<sup>11</sup> included *Anosteira* in the family *Anosteiridae*, which he erected for it. As I see no characters of *Anosteira* which exclude that genus from the *Dermatemydidae* as defined by Hay in 1908, I prefer at present to consider it a member of that family, as did Gilmore in 1931.<sup>12</sup> As the genus *Pseudanosteira* is more closely related to *Ano-*

<sup>10</sup>Hay, O. P., *op. cit.*, p. 223.

<sup>11</sup>Hay, O. P. *Bibliography and Catalogue of the Fossil Vertebrates of North America*. First Catalogue, p. 446. Second Catalogue, p. 91.

<sup>12</sup>Gilmore, C. W., *Bull. Amer. Mus. Nat. Hist.*, Vol. LIX, Art. IV, 1931, "*Fossil Turtles of Mongolia*." p. 217.

*steira* than to any other known genera of the Dermatemydidae, it seems expeditious to group the two in one subfamily, the Anosteirinae, a name which was proposed by Lydekker in 1889.<sup>13</sup> My knowledge of the genus *Pseudotrionyx* is not sufficient to warrant my including it within or excluding it from the subfamily Anosteirinae.

## TABLE I\*

## CARAPACE.

## GENERAL DIMENSIONS

Length along midline.....	190 mm.
Greatest width (est.).....	175 mm.
Height at nuchal rim.....	42 mm.
Height at dorsal spine.....	65 mm.

## NEURAL BONES

No.	Length	Greatest width	Width at anterior suture
1	19	10	6
2	14	6.8	3.5
3	15	7	6.5
4	18.5	11	7
5	14	7	7
6	14	9	4
7	9.5	7	3.3
			posterior
			3.0

## COSTAL BONES

No.	Length, anterior border	Width, proximal	Width, distal
1	29	15.5	33
2	54	19	25
3	70	17	24
4	73	16	25
5	72	17	22
6	68	15	23
7	56	12	18
8	46	14	17
	posterior		
	28		

<sup>13</sup>Lydekker, R. Cat. Foss. Rept., III, 1889, p. 143.

\*Dimensions in millimeters.



## PERIPHERALS

No.	Length, anterior border	Width, proximal	Width, distal
1	11 (est.)	16 (est.)	21 (est.)
2	11	16	17
3	14 (est.)	21	25
4	19	16	24
5	21	19	21
6	21	22	22
7	20	23	31
8	28	22	29
9	25	20	26
10	25	24	27
	posterior		
	17		

## NUCHAL BONE

Width along anterior rim	Length along midline	Length along lateral border
45 (est.)	25	11 (est.)

## SUPRAPYGAL BONE

Length along midline	Length of posterior border
25 (est.)	37 (est.)

## VERTEBRAL SCUTES

No.	Greatest length	Length along midline	Width, anterior	Greatest width
1	57	32	29	29
2	46	46	14	19
3	55	46	16	28
4	11	9	14	17
5	37 (est.)	37 (est.)	14	58 (est.)

## COSTAL SCUTES

No.	Length, anterior	Width, proximal	Width, distal
1	..	42	66
2	60	36	46
3	61	32	46
4	51	23	32

## MARGINAL SCUTES

No.	Length, anterior	Width, proximal	Width, distal
5	22	19 (est.)	23 (est.)
6	21	21 (est.)	23 (est.)
7	20	28	28
8	21	24	30
9	27	18	27
10	24	20	29
11	22	29 (est.)	31 (est.)

## NUCHAL SCUTES

Length along midline	Greatest antero- posterior length	Length along anterior rim
10	14	36

## TABLE II

## PLASTRON

Width of plastron at bridges.....	152
Length of plastro-carapace suture.....	47
Length of lateral hyo-hyoplastral process.....	52
Length of hyo-hyoplastral suture.....	71
Length of hypo-plastron at midline.....	28
Width of posterior lobe at its base.....	42